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# **Understanding and Application of Learning Theory in UK-based Equestrians**

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## **Abstract**

Learning in equines occurs through a predictable chain of stimulus–response–consequence processing. Whether the behavior persists will depend on the nature and timing of the consequence, whether it punishes or reinforces the response behavior. Knowledge and application of learning theory in UK-based equestrians was assessed by an online survey which probed three aspects of knowledge and understanding. Fifty-eight UK individuals (91% female) took part in the study and had an average of 12.4 years' equestrian experience. Almost one-third (31%) described themselves as professional equestrians. A questionnaire was used to assess participants' ability to identify and describe terminology associated with learning theory; self-report on their own knowledge and training methodology; and to express how they would respond in different training situations. Human-focused educational strategies were tested to assess their effectiveness and suitability for increasing understanding of learning theory. Professional equestrians expressed higher levels of subjective knowledge than amateurs ( $t_{(27)} = -2.752, p = 0.018$ ), with a moderate positive correlation between subjective knowledge and observer-scored knowledge ( $r = 0.443, p < 0.001$ ).

Professionals scored higher than amateurs on all questions asked, however a deficit of knowledge was observed across the board; in particular, in defining positive punishment (professional 38.8%, amateur 12.5% successful) and negative reinforcement (professional 33%, amateur 12.5% successful). Application of both an educational video and a leaflet increased respondents' ability to correctly define terminology (Video  $t_{(8)} = -4.07, p = 0.004$ ; Leaflet  $t_{(12)} = -5.02, p < 0.001$ ). Improving understanding and application of learning theory in amateurs and professionals alike has the potential to improve equine welfare and training outcomes for both leisure and performance horses through reducing wastage attributed to behavioral problems or poor training.

Keywords: education, equitation, learning theory, reinforcement, welfare

Approximately 1.3 million people in the UK ride horses regularly (BETA National Equestrian Survey 2015). Studies suggest up to 90% of horses kept for leisure purposes display undesirable behaviors when ridden (Hockenhull & Creighton, 2013), which it has been suggested are due to inappropriate training or misapplication of training techniques, leading to the manifestation of behaviors indicative of conflict (McGreevy and McLean, 2005; McLean & McGreevy, 2006). The successful training of horses follows the principles of learning theory (Potter & Yeates, 1990) and is based on the interaction of stimulus, response, and consequence (Cooper, 1998). The aim of all training is to increase/decrease the probability of behaviors being repeated on subsequent interactions with the original stimulus (Chance, 2003). This occurs through the use of reinforcement and punishment. Reinforcement can be positive, where the addition of a desirable consequence (such as an appetitive reward) increases

the likelihood of the behavior recurring (MacDonald, 2003), or negative, where an aversive stimulus is removed directly after the performance of the desired behavior (such as removal of pressure, Skinner 1953). Complex behaviors can be trained by shaping; using successive approximation and reinforcing each attempt the horse makes in the correct direction. Punishment can also be categorized as positive (something aversive is applied immediately after the undesired response) or negative (something desirable is removed after the unwanted response) and is applied to reduce the probability of the behavior recurring (Skinner, 1953). However, the use of punishment in horse training is not always effective (McLean, 2003) as horses may not form associations in the way trainers would expect, and it can therefore provoke further unwanted behaviors (Mills, 1998).

Previous studies demonstrate that the terminology associated with learning theory is often misunderstood (Chance, 2003; Warren-Smith & McGreevy, 2008) and as such may be misapplied in training situations. Incorrect application of the principles of learning theory has been associated with the development of undesirable behaviors in ridden horses (McGreevy & Mclean, 2007) and at its worst can be detrimental to welfare. In particular, the misuse of negative reinforcement can inadvertently punish behaviors if the timing of the release of stimulus is not appropriate (McGreevy, 2004), and lack of release can give contradictory signals to the horse leading to behaviors indicative of conflict (McGreevy & Mclean, 2010). Why this misunderstanding occurs is not known; however, it is proposed that the emotional valence of the language used in learning theory terminology may be a contributing factor. Humans are known to perceive language in an emotional context (Lindquist & Gendron, 2013; Barrett et al., 2007) and as such it is proposed the use of the terms “positive” and

“negative” in learning theory terminology, while originally used in their purest form as mathematical gradients, may cause confusion due to their more common usage as synonyms for “good” and “bad.”

While the question of terminology may be considered purely semantics by some, an in-depth understanding of the methodologies used in the sport is key to effective coaching (Abraham & Collins, 1998), and full knowledge of the principles of reinforcement and punishment and how they should be applied may be considered critical in fulfilling the training potential of both horses and riders. As such, effective methods to disseminate this information are required. Dale’s cone of experience (Dale, 1969) is a theoretical model that postulates on the effectiveness of various forms of educational material on long-term retention of information, from direct purposeful experience at the base through demonstrations, video, and verbal symbols at the tip. While there are no hard and fast rules as to how people retain information, and studies have shown individuals will perceive learning material differently (Pashler et al., 2008), this does provide a structured framework upon which to test suitable learning materials for dissemination of information in a society where online learning is becoming more accessible and popular (Ensher et al., 2003).

### ***Rationale of the Present Study***

Appropriate application of learning theory in horse training is key to reducing behavioral wastage, enhancing the training potential of horses under our care, and improving ridden horse welfare (McGreevy, 2004). Determining why learning theory is often misunderstood and developing methods to improve dissemination of information to instructors and leisure-horse owners alike may facilitate this change

towards enhancing the human–horse relationship, and improve horse welfare and human safety. The objective of this project was to determine participants’ understanding and application of equine learning theory methods through a questionnaire survey with a combination of situational and exploratory questions. Furthermore, the present study piloted the effectiveness of three different types of educational material on information about equine learning theory.

## **Methods**

Participants were recruited online using a snowball recruitment technique. A web-link to the study was distributed through social media, which was shared and redistributed by various equestrian organizations and individuals. Data collection lasted for a period of 12 weeks. Online sampling allowed individuals to complete the study at a time that was convenient for them and in the comfort of their own homes. However, due to the distribution process used, individuals with no access to the internet or who did not frequent social media and forum sites were not able to participate.

## ***Questionnaire***

The questionnaire was hosted by SurveyMonkey Pro. At the beginning of the questionnaire, demographic questions were asked including sex, age, equestrian experience (in years), disciplines participants were involved in, horse ownership, and qualifications in equine training or animal behavior. Participants were asked to classify themselves as either amateur (making no financial income from horses), semi-professional (making part of their financial income from horses), or professional (obtaining all of their financial income from horses). Participants’ subjective knowledge of equine learning theory, training beliefs they held, and methods they

believed they used in training were measured on a numerical scale, from 1 (Not at all) to 5 (Very much). Participants were asked to provide a definition of five key learning theory terms (positive reinforcement, negative reinforcement, positive punishment, negative punishment, and shaping), allowing an independent knowledge evaluation. In order to avoid misleading results due to participants' differing abilities to express their thoughts, multiple-choice options for two principles of learning theory (reinforcement and punishment) were also incorporated.

Knowledge of learning theory terminology was determined by combining all three measures: a summative score was created. Participants' self-reported training methods were assessed by providing a range of training methods to identify with. To determine whether participants were using principles of learning, and what elements of learning theory they were using, different scenarios were provided. How participants believed they would react in a given training situation was assessed through two questions (1. "Your horse has just performed a well-executed movement during training, what is the first thing you do?" and 2. "All the horses in your stable have just been given their evening feed when you notice one has a near empty water bucket. When you enter the stable to collect the bucket the horse kicks out at you, how do you respond?"), with a number of possible responses corresponding to different types of reinforcement or punishment. Individuals were also asked to describe how they trained a new technique ("You are teaching your horse a new movement, which of the following do you do?") and given multiple-choice options relating to the shaping. Individual responses were scored based on which principle they said they would apply, and for explanatory questions individuals were given scores for every correct or partly correct key phrase

that was used in their definition (using Table 1). Responses were then compared with the self-report of methodology used.

### ***Educational Interventions***

Three types of interventions were used to provide information about equine learning theory. The learning outcome of the interventions was assessed by means of comparisons between them. The SurveyMonkey Pro logic function was used to allow individuals to be randomly assigned an educational intervention, using month of birth as the randomization factor. The “passive” intervention group received a leaflet outlining the basic principles of equine learning theory. The “active” intervention group was directed to watch a YouTube-hosted video that described the basic principles of equine learning theory with filmed examples (<https://www.youtube.com/watch?v=HxZZGcM3FiQ>). The “interactive” intervention group was directed to a short simulation hosted by the University of Wisconsin, where participants could train a bird to press a button using positive reinforcement and shaping (<https://pantherfile.uwm.edu/johnchay/www/ocOLD.htm>).

Participants were asked to confirm whether they completed the intervention as directed and were then asked to complete the immediate post-test questionnaire. This questionnaire contained the same questions as before, excluding the demographic section and the scenario evaluation, and was designed to determine how effective the educational tools were at improving participants’ knowledge of learning theory terminology and whether self-evaluation may have changed.



### ***Ethical Approval***

The study was approved by the college of medicine and veterinary medicine Human Ethical Review Committee (HERC) of the University of Edinburgh (2014). The questionnaire and interventions were pre-tested prior to being available online, and completion time was between 20 and 25 minutes.

### ***Statistical Analysis***

Data were exported from SurveyMonkey Pro and analyzed using GraphPad and Minitab v16 statistical software. Summative scores were calculated for individuals' subjective knowledge and application of learning theory. Anderson-Darling tests were applied to check data were normally distributed (Subjective knowledge AD = 2.126,  $p < 0.005$ ; Application of learning theory in training AD = 2.204,  $p < 0.005$ ). Basic between-group comparisons in knowledge and understanding of learning theory terminology were calculated using chi-square tests and two-way  $t$ -tests. Differences between the effectiveness of educational interventions were calculated using a one-way Analysis of Variance to compare between and within multiple groups, and a  $t$ -test was used for pairwise comparisons.

## **Results**

### ***Participants***

In total, 58 UK people participated in this study; 91% ( $n = 53$ ) were female and 9% ( $n = 5$ ) male. The mean age was 38 years ( $SD = 11.9$ ). Participants' equestrian experience was on average 22.4 ( $SD = 12.4$ ) years. Most participants (69%,  $n = 40$ ) reported to be equestrian amateurs, followed by 17.2% ( $n = 10$ ) semi-professionals and 13.8% ( $n = 8$ ) professionals. Current horse owners made up 82.8% ( $n = 48$ ) of

respondents, and 17.23% ( $n = 10$ ) reported previous educational experience in animal behavior, of which 70% were professionals or semi-professional equestrians. For statistical analysis, two groups were formed: amateur ( $n = 40$ ) and professional ( $n = 18$ ). Detailed participant information can be found in Table 2.

### ***Knowledge of Learning Theory***

Subjective knowledge differed significantly between professionals ( $M = 3.22$ ,  $SEM = 0.33$ ) and amateurs ( $M = 2.27$ ,  $SEM = 0.18$ ), with professionals expressing higher levels of subjective knowledge than amateurs (two sample  $t$ -test:  $t_{(27)} = -2.752$ ,  $p = 0.018$ ; Cohen's  $d = 1.06$ , indicating a large effect). A moderate positive correlation between subjective knowledge and observer-scored knowledge was found ( $r = 0.443$ ,  $p < 0.001$ ), suggesting a level of knowledge and understanding prior to the start of the survey.

No significant difference was found between preferences for a particular training method, with 22.2% ( $n = 4$ ) of semi-professional and professional equestrians reporting having no preference, compared with 17.5% ( $n = 7$ ) of amateurs ( $\chi^2_{(1)} = 0.18$ ,  $p = 0.671$ ), and 44.4% ( $n = 8$ ) and 42.5% ( $n = 17$ ), respectively, reporting using various methodologies. In both groups, approximately one-quarter of individuals reported the belief that natural horsemanship techniques were more humane than traditional methods (Amateur 25%,  $n = 10$ ; Semi-professional/Professional 22%,  $n = 4$ ); however, both groups showed an overall tendency towards disagreement with the statement (Professional  $M = 2.278$ ,  $SEM = 0.301$ ; Amateur  $M = 2.525$ ,  $SEM = 0.215$ ) (Table 3).

Most professional ( $n = 17$ ) and amateur riders ( $n = 35$ ) reported being involved in the training of their own or someone else's horse. Eleven professional equestrians reported teaching riders, and four of those professionals reported applying the principles of learning theory in their teaching. However, only two were found to be able to correctly define negative reinforcement or positive punishment.

### ***Reinforcement***

Most (88.9%,  $n = 16$ ) of the professional and amateur equestrians (85%,  $n = 34$ ) were able to identify a reinforcer as “something that increases the likelihood of a behavior recurring.” There was no significant difference between professional and amateur equestrians' ability to define positive reinforcement (Figure 1). Professional equestrians were marginally more successful in defining negative reinforcement than amateur equestrians, with 33.3% ( $n = 6$ ) providing a full, correct description compared with 12.5% ( $n = 5$ ) of amateurs ( $\chi^2_{(1)} = 3.506, p = 0.06$ ; Figure 1). However, 22.5% ( $n = 9$ ) of amateur equestrians incorrectly described negative reinforcement as positive punishment. Interestingly, both groups had greater success defining pressure-release (semi-professional/professional 88.9% ( $n = 16, \chi^2_{(1)} = 11.688, p = 0.001$ ; amateur 77.5% ( $n = 31, \chi^2_{(1)} = 34.141, p < 0.001$ ).

When asked how they would respond when a horse performed a ridden exercise well, more amateur equestrians (62.5%,  $n = 25$ ) than professional equestrians (50%,  $n = 9$ ) chose the scenario using positive reinforcement (or “other” and described positive reinforcement), while a higher proportion of professional equestrians (44.4%,  $n = 8$  vs 35%,  $n = 14, \chi^2_{(1)} = 2.799, p = 0.09$ ) chose the scenario using negative reinforcement (Figure 2). This was even more apparent when the professionals and semi-

professionals were analyzed separately, with 75% ( $n = 6$ ) of professionals choosing to use negative reinforcement compared with 20% ( $n = 2$ ) of semi-professionals, indicative of a dilution effect when combining the two groups in this situation ( $\chi^2_{(1)} = 55.78, p = < 0.001$ ). One individual chose to not reinforce the behavior but to carry on to the next movement.

### ***Punishment***

More professional (66.7%,  $n = 12$ ) than amateur equestrians (57.5%,  $n = 23$ ) were able to identify a punisher as “something that decreases the likelihood of a behavior recurring,” although this did not reach statistical significance. Similarly, when asked to describe positive punishment in their own words, significantly more professional equestrians (38.8%,  $n = 7$  vs 12.5%,  $n = 5$  amateurs) ( $\chi^2_{(1)} = 5.268, p = 0.02$ ) were able to do so to the criteria required (Figure 3).

When given a scenario in which the horse displayed undesirable behavior, 55.6% ( $n = 10$ ) of professional equestrians and 62.5% ( $n = 25$ ) of amateur equestrians chose the response describing positive punishment (or described punishment themselves). Interestingly, only 30% ( $n = 3$ ) of those professionals and 12% ( $n = 3$ ) of those amateurs choosing this response had correctly defined positive punishment in the self-description section. Similar levels in both groups (Professional 22.2%,  $n = 4$  and Amateur 20%,  $n = 8$ ) chose the description of a response which would serve to negatively reinforce the behavior by withdrawing from the animal’s space (Figure 4). One individual within the amateur group chose to negatively punish by removal of resources. In this situation, no difference was observed between professionals and semi-professionals ( $\chi^2_{(1)} = 0.001, p = 0.98$ ).

### ***Shaping***

Significantly more semi-professional and professional equestrians (55.6%,  $n = 10$ ) than amateurs (20%,  $n = 8$ ) were able to correctly define shaping ( $\chi^2_{(1)} = 7.332, p = 0.007$ ). However, only a marginally higher proportion of professionals than amateurs (77.8%,  $n = 14$  vs 67.5%,  $n = 27$ ) chose the response describing shaping in the situational questions (by using successive approximation and rewarding each attempt the horse makes in the correct direction).

### ***Application of Principles of Learning Theory***

When asked directly which of the components of learning theory participants used during training, significantly more professionals (55.5%,  $n = 10$ ) than amateurs (27.5%,  $n = 11$ ) reported using negative reinforcement ( $\chi^2_{(1)} = 4.23, p = 0.04$ ). There was a trend towards more amateurs (42.5%,  $n = 17$ ) than professionals (27.8%,  $n = 5$ ) reporting using pressure-release. Of those individuals who did not report using negative reinforcement or pressure-release ( $n = 23$ ), 39.1% ( $n = 9$ ) had chosen the response describing negative reinforcement/pressure release in the ridden situational question, and none could correctly define negative reinforcement. One individual/participant explicitly stated using pressure-release and positive reinforcement while “trying to avoid” negative reinforcement, suggestive of a lack of understanding of the terminology involved. Furthermore, 44.4% ( $n = 8$ ) of professionals self-reported using positive punishment, compared with just 15 % ( $n = 6$ ) of amateurs ( $\chi^2_{(1)} = 5.877, p = 0.015$ ). Of those individuals (regardless of group) who did not report using positive punishment ( $n = 44$ ), 40.9% ( $n = 18$ ) chose the response describing positive punishment in the handling situational question. Similar

to negative reinforcement, none of those individuals who failed to report using positive punishment could correctly define this methodology. Almost all participants reported using positive reinforcement, with the exception of seven individuals in the amateur group (17.5%), who stated they did not know what methods they used.

### ***Educational Intervention***

Forty-four individuals completed the educational intervention. Fifteen individuals (34.1%) were professional equestrians and 29 were (65.9%) amateur equestrians. Mean years of equestrian experience across all groups was 23 years ( $SE = 2.13$ ). Table 4 provides an overview of the intervention groups.

The “interactive” group had a significantly higher pre-intervention mean knowledge score (as calculated from their total knowledge scores for the self-description of learning theory methodology section) than those in the other three groups ( $F_{(3,40)} = 2.92, p = 0.046$ ). They did not show a significant increase in ability to define learning theory terms immediately post intervention ( $t_{(6)} = -1.87, p = 0.11$ ) (Figure 5a). Both the “passive” and the “active” groups performed significantly better in defining learning theory terminology immediately post intervention (Video  $t_{(8)} = -4.07, p = 0.004$ ; Leaflet  $t_{(12)} = -5.02, p < 0.001$ ). No significant difference was observed between the “passive” and “active” groups in change in ability to describe learning theory terminology ( $t_{19} = 0.52, p = 0.61$ ) (Figure 5b).

Of those individuals who reported using pressure-release but not negative reinforcement pre-intervention ( $n = 16$ ), all stated using negative reinforcement post intervention. Similarly, a change in self-reported use of negative reinforcement was

observed in those who had previously not stated the use of either negative reinforcement or pressure-release ( $n = 8$ ), with 50% ( $n = 4$ ) reporting using negative reinforcement post intervention under all educational strategies. Overall, 55% ( $n = 17$ ) of those individuals altered their response immediately post intervention, with an increase in self-reported use of negative reinforcement ( $n = 16$ ) and positive punishment ( $n = 8$ ) most apparent.

## **Discussion**

### ***Knowledge and Application of Learning Theory in UK-based Equestrians***

Professional equestrians included in this study displayed a marginally greater overall knowledge of learning theory terminology than amateur equestrians. However, there was a distinct deficit of knowledge in both groups, particularly relating to an understanding of negative reinforcement and positive punishment. A high proportion of individuals in this study were able to correctly identify a reinforcer ( $> 86\%$ ) and a punisher (with slightly less success,  $> 60\%$ ) from a list of descriptions provided. In line with previous work focusing on equestrian coaches working under the Australian coaching system (Warren-Smith & McGreevy, 2008), and the Canadian coaching system (Wentworth-Stanley, Randle, & Wolfram, 2014), approximately two-thirds of professional equestrians were unable to correctly define negative reinforcement and over 60% were unable to correctly define positive punishment in their own words. Similarly, almost one-quarter of amateur equestrians described negative reinforcement as positive punishment, suggestive of a misunderstanding spanning the equestrian community that may require addressing on a global scale. These terms are commonly confused as both involve the use of aversive stimuli (Chance, 2003). However, the essential difference is that reinforcement increases the likelihood of the response

occurring again, while punishment should decrease the likelihood of that response occurring again (Lieberman, 2000). The use of the terms “positive” and “negative” are intended in their purest mathematical sense (i.e., positive—*to add*, negative—*to subtract*) and as such it has been suggested that negative reinforcement and positive punishment form part of a continuum where the timing of application is key to determining whether the stimulus is considered reinforcing or punishing (McGreevy, 2004). Both lack of understanding of this continuum and how the principles of learning theory should be applied to horse training could pose significant welfare risks to the horse (McLean, 2005) and safety risks to the human handler (Newton & Neilson, 2005).

Terminology surrounding basic equine learning theory is commonly misconstrued, with positive and negative being taken with an emotional value either relating to the appropriateness of the stimulus or of the reaction (McConnell, 1990; Tauber, 1988). Indeed, evidence from the descriptive questions highlighted a number of individuals using elements of negative reinforcement to describe positive reinforcement, and elements of positive punishment to describe negative reinforcement. It could be suggested that the “positive” and “negative” aspects of terminology were in some way being understood to refer to the appropriateness of the horses’ behavior, such that positive reinforcement was a favorable response by the trainer to reward a desirable behavior, while negative reinforcement was seen as an aversive response to correct undesirable behavior. Misunderstanding has previously been reported in early-stage psychology students, so it is unsurprising this exists in individuals with little or no background in behavioral science or psychology (Sheilds & Gredler, 2003).



Interestingly, despite a poor ability to define negative reinforcement, over 80% of individuals correctly defined pressure-release, suggesting that the underlying practical terms may be understood in the absence of understanding the full terminology (McLean, 2005). While this result is in itself favorable, an understanding of the importance of contiguity and contingency is imperative to prevent pressure-release progressing along the continuum to positive punishment (McLean & McGreevy, 2010). Further investigation of aspects of terminology and application of methods in a practical sense would be beneficial to determine if the terminology is perhaps viewed as over-complicated and in need of reform (Michael, 1975; Perone, 2003), or if an increase in available educational strategies is required to improve knowledge (Sheilds & Gredler, 2003). Analysis of descriptive answers provides evidence for a general understanding of the application of pressure-release as a reinforce; however, a number of individuals incorrectly used it to describe positive reinforcement, as previously observed in other studies (Sheilds & Gredler, 2003; Warren-Smith et al., 2008).

A number of individuals, when asked to describe positive punishment, responded with “no punishment can be positive,” again indicating an emotional connotation to their understanding of the terminology (Lindquist & Gendron, 2013). Similarly, one individual reported using pressure-release but actively avoided the use of negative reinforcement. While these could indeed be the beliefs of the participants, it is worth noting that subjective questionnaires such as this are open to self-report bias (Bertrand & Mullainathan, 2001), which may provide what they perceive as the most socially acceptable answer. While this does not negate the fact that the terminology may elicit an emotional response, it should be considered when drawing conclusions from these statements. It may be suggested from the results gathered in the initial survey section

that the emotional valence commonly attached to the terms “positive” and “negative” contributes to the lack of understanding observed in this population.

It is concerning then that a mismatch between the self-reported use of certain principles of learning theory and the observer-reported use was found for both negative reinforcement/pressure-release and positive punishment, with significantly more individuals choosing the responses relating to negative reinforcement and positive punishment than self-reporting their use. This is likely due to a lack of understanding of the terminology used, and while it may be argued that theoretical knowledge of the principles and terminology of equine learning theory may not necessarily influence the practical application (and indeed correct application of methodology is the ultimate goal), it could be considered foolish to believe that full training potential can be achieved in the absence of basic theoretical knowledge (Mills, 1998)

Whether the original operant conditioning terminology of learning theory is required to understand the principles and their practical application is a topic of debate (Baron & Galizio, 2005; Baron & Galizio, 2006), and the distinction between positive and negative reinforcement increasingly blurred as our understanding of how these actions are processed by the animal increases. It has been suggested that as both positive and negative reinforcement strategies appear to be processed by the same neural networks (Ikemoto & Panksepp, 1999; Bromberg-Martin, Matsumoto, & Hikosaka, 2010), it is in fact more important to understand the difference between reinforcement and punishment, and contingency (stimulus/response order) and contiguity (timing), in training methods to improve welfare and safety, than stringently holding to potentially

confusing terminology. This is particularly so when it has been proposed that positive and negative reinforcement may not be perceived differently by the animal and cannot ever be mutually exclusive states (Gallistel, 2002; Innes & McBride, 2008). The observation that pressure-release is a more widely recognized and more easily defined (and understood) term than negative reinforcement suggests that either the original terminology is prohibitive or those individuals or schools who are promoting “alternative” training methodologies are better at marketing and targeting the “average” equestrian, who has little or no background in behavioral science. The emergent popularity of methodologies under the natural horsemanship umbrella (such as Parelli Natural Horsemanship, Monty Roberts Join up, or Jeffries approach and retreat), all of which have their roots in the operant conditioning method of negative reinforcement (Miller, 2007) and all of which are at their core not dissimilar to traditional methods, is testament to both the desire of UK equestrians to learn more about equine behavior and training and the marketing of such programs, which have managed to make traditional theory appear new and fresh.

### ***Educational Strategies***

Both the leaflet and the video strategy performed equally well in increasing knowledge scores immediately post intervention. Perhaps the most striking change was in self-reported methodology use post intervention, with over half of individuals reporting the use of extra principles post intervention. This was most apparent in the reported use of negative reinforcement and positive punishment, lending weight to the assumption that the previous mismatch observed between self-reported use and observer-scored use may be down to a lack of understanding of the terminology. Lack of theoretical knowledge is thought to be detrimental to welfare (Mills, 1998), while

others argue that the terminology in its current state is outdated (Baron & Galizio, 2006). The popularity and success of the natural horsemanship movement, which uses the same basic principles with different terminology, would suggest this to be the case. However, a more in-depth study to determine whether individuals understand the practical consequences of their actions in the absence of an understanding of the terminology would be useful. Certainly, with the continued high levels of behavioral wastage of equines worldwide (Ödberg, 2005), this is an area which warrants further study globally.

Contrary to expectations (Papastergiou, 2009; Zhang, Zhou, Briggs, & Nunamaker, 2006), the interactive educational strategy performed worst out of those tested. By chance, individuals within this group had a significantly higher pre-intervention knowledge score (based on their ability to define learning theory terms) and as such had less scope for knowledge increase within the parameters of the test than those in the other groups.

## **Conclusions**

Professional equestrians show a marginally greater knowledge of learning theory and are more aware of the principles they apply during equine training than amateurs. However, a significant deficit in knowledge was evident and a substantial mismatch between self-reported use and observer-scored use of learning theory principles was present. While it is concerning such a mismatch occurs, which could potentially lead to misapplication of learning theory principles that would be detrimental to equine welfare in training (McLean, 2005), it is promising that simple educational strategies such as those employed in this study could help to rectify this. Further work should

aim to develop an easily assessable educational strategy to improve knowledge and understanding of equine learning theory in UK equestrians. This may be used for both continued professional development for professionals and as a tool for increasing knowledge of equine behavior in amateur equestrians. It is proposed that an in-depth knowledge of the application and utilization of learning theory principles, regardless of the terminology that may be used, is of critical importance to effective and welfare-friendly horse training (McLean, 2005). This could reduce behavioral wastage and safeguard equine welfare (McGreevy, 2004).

### **Conflict of Interest**

The authors declare no conflicts of interest.

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Table 1. Definitions of reinforcement and punishment, as first described by Skinner (1953) and adapted from Warren-Smith et al (2008). Participants responses were required to align to these definitions to be deemed correct.

	<b>Positive</b>	<b>Negative</b>
Reinforcement—the procedure of providing consequences for a response that maintain or increase its occurrence	Addition of something desirable to reward the desired response	The removal of something aversive to reward the desired response
Punishment—the procedure of providing consequences for a response that reduce its occurrence	The addition of something aversive after the undesired response	The removal of something desirable after an undesirable response

Table 2. Sub-group age and experience summary table. Age and experience are in years. For the analyses, Professional and Semi-professional were grouped as “Professional” ( $n = 18$ ), and High-level Amateur and Average Amateur grouped as “Amateur” ( $n = 40$ ).

<b>Group (<i>n</i>)</b>	<b>Mean Age (<i>SD</i>)</b>	<b>Experience Mean (<i>SD</i>)</b>	<b>Qualifications Listed</b>
Professional (8)	41.5 (11.92)	29 (13.18)	1 no qualifications  2 British Horse Society stage1–2  2 British Horse Society stage 3  4 British Horse Society Assistant Instructor  1 Fellow of the British Horse Society  1 Intermediate Instructor  1 UK Coaching Certificate level 2  1 degree  1 TTEAM level 1
Semi-professional (10)	37.2 (11.56)	23.7 (13.36)	1 no qualifications  3 British Horse Society stage 1–2  2 British Horse Society stage 3

			<p>1 British Horse Society Assistant Instructor</p> <p>1 British Horse Society preliminary teaching test, 1 UK Coaching Certificate level 1</p> <p>1 UK Coaching Certificate level 2</p> <p>1 HND horse management</p> <p>1 Natural horsemanship qualifications</p>
High-level Amateur (8)	30.4 (5.58)	20.5 (5.37)	<p>5 no qualifications</p> <p>1 Pony club B test</p> <p>2 British Horse Society stage 1–2</p>
Average Amateur (32)	37.5 (12.72)	18.8 (13.56)	<p>26 no qualifications</p> <p>1 Pony club B test</p> <p>6 British Horse Society stage 1–2</p> <p>NVQ racehorse management</p> <p>UK Coaching Certificate level 1</p>

Table 3. Self report of knowledge and training methodology in UK-based equestrians. Items were rated on a scale from 1 (not at all) to 5 (very much). Each cell represents the total number in this category; number in brackets represents the number per group (amateur, professional)

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Are you aware of the principles of equine learning theory?	16 (13, 3)	12 (10, 2)	17 (12, 5)	7 (3, 4)	6 (2, 4)
Do you consider “natural horsemanship” to be more humane than “classical training”?	21 (13, 8)	8 (7, 1)	15 (10, 5)	10 (6, 4)	4 (4, 0)
Do you have any strong beliefs about training methods/follow a regime rigidly?	11 (8, 3)	4 (3, 1)	25 (17, 8)	10 (8, 2)	8 (4, 4)

Table 4. Educational strategy group and experience summary table. Age and experience are in years.

<b>Group (<i>n</i>)</b>	<b>Mean Age (<i>SD</i>)</b>	<b>Gender Ratio (M:F)</b>	<b>Experience Mean (<i>SD</i>)</b>
Leaflet (15)	38.7 (15.5)	1:14	21.5 (13.9)
Video (9)	35.2 (11.2)	1:8	23.7 (15.3)
Interactive (7)	37.5 (10.6)	1:6	23.9 (13.1)



Figure 1. Scored self-report definitions for reinforcement terminology. Bars represent percentage of each group giving incorrect (score 0), partially correct (score 1), and totally correct (score 2) definitions. Definitions of positive reinforcement are on the left and those of negative reinforcement are on the right.

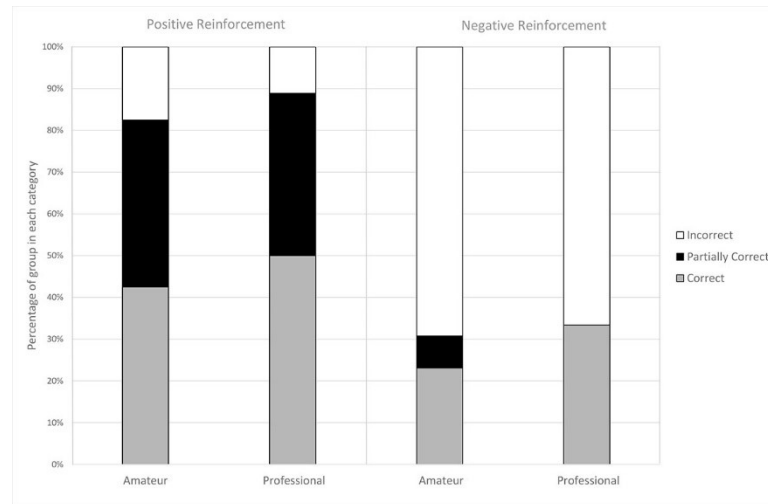


Figure 2. Responses to situational example A by UK-based equestrians. Question A demonstrates examples of how positive and negative reinforcement could be used in ridden situations. Standard text in the key is the answer chosen; italicized text is the learning theory method used.

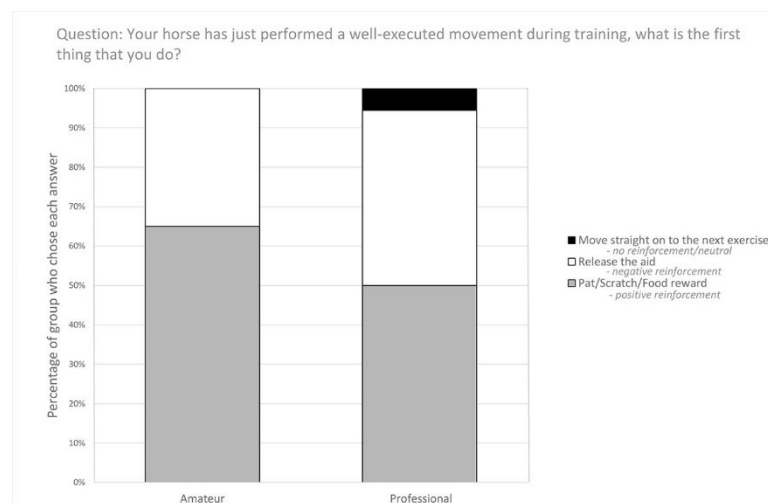


Figure 3. Scored self-report definitions for punishment terminology. Bars represent percentage of each group giving incorrect (score 0), partially correct (score 1), and totally correct (score 2) definitions.

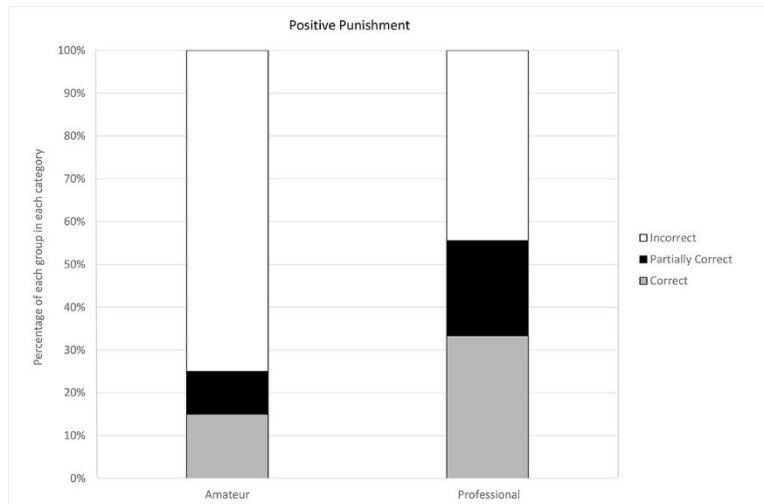


Figure 4. Responses to situational example B by UK-based equestrians. Question B demonstrates the use of positive punishment and negative reinforcement of an undesired behavior. Standard text is answer chosen; italicized is learning theory method used. \*one individual in this category chose “other” then stated “this horse may be chastised with the whip.” As this would still be a demonstration of positive punishment (although more severe than given in the scenario choices), they have been included here.

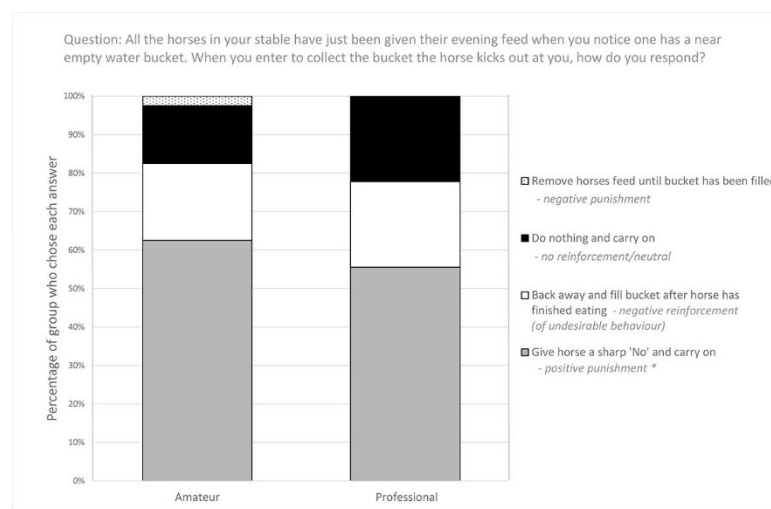


Figure 5. Effect of educational interventions on observer-scored knowledge of learning theory terminology. Panel a. shows mean knowledge score per randomly allocated group both pre- and post-educational intervention. Educational strategies are listed on the x-axis. Panel b. shows the mean change in knowledge score per educational intervention. Error bars in both panels represent standard error of the mean. Significance levels denoted by  $*p < 0.05$  and  $***p < 0.001$ .

